

TOP SECRET

TICOM/M-2

MAJOR BARLOW'S REPORT
ON
DR. VIERLING'S LABORATORY

This is a report on Dr. Vierling's communication research laboratory at Ebermannstadt. The investigation of the laboratory was made by Major Barlow and Major Heller. Major Heller's preliminary report appears in TICOM/M-1.

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21 June 1945

MEMORANDUM TO COLONEL GEORGE A. BICHER

Subject: Investigation of Laboratorium Feuerstein

1. This report is to cover the technical investigation of the Laboratorium Feuerstein whose main laboratories are located in Ebermannstadt, near Nuremberg, Germany, and which at one time had sections from it at Kirchentall, St. Martin, below Lofer, and whose second subsidiary group is located in Pinzberg, near Ebermannstadt. (Map Ref. WO 42). The investigation of this laboratory was conducted by Major H. C. Barlow, Signal Intelligence Division, Office of the Chief Signal Officer, Hq ETOUSA, and by Major Heller (British) Signal Intelligence, G-2, SHAEP.

2. The Laboratorium Feuerstein was originally established in Ebermannstadt and its primary mission was the development and research on audio frequency circuits and associated apparatus. Before the occupation of this territory by the United States Army, this laboratory employed approximately 150 men in a large and excellently equipped laboratory which is entirely undamaged. The laboratory has complete machine shops for the forming of all materiel as well as an excellent supply of all laboratory instruments and meters needed for voice frequency research. On approximately April 15th the German High Command ordered that a certain section of this laboratory gather its more completed projects on speech scrambling and move from this district to the area in the Bavarian Alps near Berchtesgaden, Germany. Eventually this laboratory was located in Kirchentall where it practically never got into operation.

3. The laboratory in Kirchentall was found to contain three projects which were not completed, but were well enough advanced to explain the technical principles involved;

a. The first project was called Development "Gleichlauf". Development "Gleichlauf" consisted of a teletype scrambler apparatus which

rather had its synchronization provided by frequency generator. The cipher mechanism presently used was the old version of the standard German teletype scrambler, sometimes called the Geheim Fernschreiber and known to Allied Forces as the "Fish". The cipher principles involved were unchanged, but the motor drive had been changed to a synchronous motor which receives its power from the Crystal controlled frequency generator. When there is no transmission to be enciphered, the "Gleichlauf" continues to send out cipher key, the purpose being to disguise the amount of traffic handled over the circuit as well as to conceal the actual place where message texts starts. In addition to dispensing with the start-stop pulse, this method of synchronization offers the advantage of maintaining cryptographic synchronization during a period of fading or any form of man-made interference which might interrupt the radio teletype channel. However, it is felt by the German personnel involved that the sending out of continuous key for a 24 hour period seriously compromises the present coding arrangement, so it had been planned to provide a cipher control mechanism of 15 disks rather than the normal 12 in this machine so as to permit the formation of a cipher key using a period of approximately 36 hours. As a new setting would be made every 24 hours, there would never be any repetition of the cipher key being used. In addition to whatever advantages this machine may have in sending out pure teletype transmissions, it also serves as the basic cipher key for several types of high grade scramblers which will be described later.

b. "Baustein" was intended to be a medium grade voice scrambler to provide local security over internal landlines, but it was never intended to provide high grade telephone scrambler security over radio channels. In this development the only portion of the speech passed was that portion between 400 and 1300 cycles, the rest being eliminated by band pass filters. The voice frequencies were alternately transmitted in the normal manner and then inverted and transmitted in the 1400 to 2700 cycle region. To complement this transmission, when the voice frequency was in the lower band, the band between 1400 and 2700 cycles was filled by miscellaneous noise, and when the voice transmission was in the 1400 to 2700 cycle band, the 400 to 1300 cycle band was

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high and low band transmission varied between three and six cycles per second, the rate of variance being controlled by the volume of the incoming speech. This switching pulse was transmitted from the sending to the receiving instrument by means of a 340 cycle note. When completed, this device weighed approximately 75 pounds and fitted in the standard German pack transmitter case of approximately 1.2 cubic feet. This development was complete, but the existing four models had been destroyed prior to its capture.

c. High Grade Voice Scrambler (No Short Title), was constructed on the principle of synthetic speech. The incoming speech was split by means of band filters into eight consecutive frequency bands from the range of 180 cycles to 3000 cycles whose output was then rectified and amplitude modulated eight separate carrier frequencies. There was also a ninth channel which served to maintain the balance between melodic tones and pure noise in the human voice, which also modulated a ninth carrier channel. These nine carrier channels were then rapidly transposed by means of what was called the three-fold "Wobbelung". By means of beat frequencies and series parallel filter circuits, a system had been devised which served to transpose all incoming signals. These transpositions could be controlled by varying four condensers controlling the four master oscillators. The cipher key for control of these master oscillators was furnished by the "Gleichlauf" previously described in Subparagraph 1a. The theory and principle of this device was complete, but actual construction had only gone as far as giving good results on synthetic speech production and practice tests on threefold Wobbelung. This project was 50 per cent complete and some trouble had been experienced because the original design had not provided filters with sharp enough cutoff. The result was that the speech contained gaps which cut out the voice transmission and filled in with the note of one of the beat oscillators. This difficulty was being overcome by the use of filters with sharper cutoff characteristics.

4. An investigation of the personnel of the Laboratorium Feuerstein at Kirchental disclosed that eight of the supposed mechanics working in the laboratory were SS troops in civilian disguise and that the Group Chief,

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workers was identified as Doctor Werner Liebknecht, who was wanted as Codes and Ciphers Expert for OGH. The arrest and search of all personnel in this laboratory brought forth approximately six hidden weapons and as a result the 101st Airborne Division CIC Detachment detained the eight SS troops and Doctor Going. Doctor Liebknecht was arrested and sent to Headquarters, United States Third Army for special interrogation. To consolidate this Laboratory for complete exploitation, the equipment, materiel, and documents of the Group at Kirchentel were removed to the main Laboratory at Ebermannstadt.

5. A superficial investigation of the projects which had been perfected at the Laboratories at Ebermannstadt were found to be the following:

a. The Acoustical Torpedo -- the torpedo which followed the sound of the propellers of any ship until impact.

b. The Anti-Radar Submarine Coating -- a coating of one quarter wave dipoles which prevented any echo from the signal sent out by submarine detection devices.

c. Nachtfee--A night fighter control based on phase displacement. Designed for the control of multiple air craft.

d. Speech Spectrum Analyzer--Originally developed by Doctor Lotz in Staats. Used as an aid in deciphering scrambled speech. Provides on film a continuous recording of the main frequencies and the energy in each frequency being received. The system is based on the Phillips - Muller recording system for oscillography.

e. Speech S_tretcher--A system of doubling or halving the speech frequency while doubling the time base. Used for speech interception and is a very effective means of cutting out interference or distortion.

f. Agents Transmitter--A transmitter for clandestine transmissions which provides for high speed keying by means of a magnetophone record and a dial system of keying. Provided with 80 KW output in very small space with crystal control on 80 selective frequencies from one crystal oscillator.

g. Multiple Frequency Generator From One Crystal--Based on multi-vibrator drive which provides stable crystal control frequencies which are not harmonics of the basic crystal frequencies. The present design allows 80

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g. Multiple Frequency Generator From One Crystal--Based on multi-vibrator drive which provides stable crystal control frequencies which are not harmonics of the basic crystal frequencies. The present design allows 80 different frequencies which can be expanded to several hundred frequencies.

h. UHF Transmitter--Provides several KW continuous output on 1 CM wave length. Works on Magnetron principle. Unconfirmed reports have rumored this device to be a basis for further research on death rays. In connection with this it should be noted that there is in existence in a neighboring laboratory a 40 KW one CM transmitter using the KLYSTRON principle.

i. Voice Frequency Spectrograph--Provides an accuracy of 10^{-7} and is an improvement on existing standards. Also used for laboratory calibration.

j. Mechanical Frequency Amplifier---Provides audio frequency output of several KW capacity from an unamplified crystal oscillator. The crystal frequency serves as a governor for a mechanical generator.

k. Radio Receiver--Principle provides untuned RF and IF stages, but yet allows high selectivity and sensitivity. Uses filters instead of tuned circuits on the RF and IF stages. The single tuning control is on the oscillator.

l. Wave Trap--Filters circuits to eliminate powerful fixed commercial stations to allow reception of weak signals. Used by the German intercept service.

m. General Filter Design--This organization has mastered the design of filters so as to provide filters of extremely sharp cutoff as well as a flat response curve. Any desired type of curve can be tailor made. The resulting filters have a negligible temperature coefficient while still being made of standard material.

6. The Laboratorium Feuerstein had the following projects still under development:

a. Calculating Machine which would instantaneously solve equations to the power of N^6 . This machine is at present complete, but not completely aligned. The results of the equation is shown as an ELYSIAN figure or spot representations on a Cathode ray tube with a calibrated grid overlay. It is possible to extend this machine to solve equations up to N^9 . The principle of operation is based on resolving the equipment into sine and co-sine functions with N^0 being the fundamental frequency whose amplitude was proportionate to the co-efficient; the 1st, 2nd, and 3rd power terms were represented by

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equations for the design of wings of high speed planes and in the design of projectiles, which formerly took 14 days to solve.

b. The Speech Writer--Intended to replace the synthetic threefold Wobbelung high grade speech scrambler as well as numerous other applications. This project was complete in principle, but only 25 per cent complete in construction. It worked on the principle of resolving speech into 25 representative symbols by means of filters and the output could be attached to any mechanical printer. The eventual application was to have the 25 symbol output of the speech writer fed into a teletype scrambler such as "Gleichlauf" and therefore the speech could be transmitted on teletype channels. The teletype speed of transmission was fast enough to keep up with the speed of speech. The vowel sounds could always be identified as the vowel letters but certain consonant sounds were arbitrarily represented by a symbol. One of the important components of this device was a special pentode tube which has the equivalent output voltage as well as control on the minimum trigger potential. The control was applied on No. 2 and No. 3 grids. The work had been completed for all vowel sounds and further analysis would be necessary to complete filter analysis for the remaining consonant sounds. 15 circuits were required for the complete resolution of the vowel sounds and the consonant sounds would require an additional 50 to 60 circuits. To complete the research on this so as to detailed principles of operation and values would require a No. 1 priority and eight weeks of time.

7. Complete technical analysis, explanation of principles of operation, and circuit values, and drawings for developments "Gleichlauf", "Baustein", and the Synthetic Speech Scrambler is now available.

8. It is understood that both Doctor Werner Liebknecht and Doctor Oskar Vierling are on the wanted list as special civilian scientists.

(SIGNED) HOWARD C. BARLOW
Major, Signal Corps

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